Abstract

Title: Ice flow acceleration of Pine Island Glacier, West Antarctica

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The grounding line of Pine Island Glacier, the largest discharger of ice in Antarctica, retreated 5 km between 1992 and 1996. During the same time period, the glacier velocity did not increase by more than 1 percent. Using new ERS-1/ERS-2 synthetic-aperture radar interferometry data from 2000, we measure flow acceleration in flow speed of the glacier, and a steady position of its grounding line. The flow acceleration propagates more than 50 km above the grounding line and is nearly proportional to the ice velocity. The result is both spectacular and unexpected for such a large glacier, which experiences nearly no surface melt. Possible causes for flow acceleration include a change in ice-shelf buttressing, or a reduction in side shearing or basal traction of the glacier. Comparison of the radar results with a finite element model of ice stream flow reveal that only a substantial removal of the ice shelf would have been able to explain the observed glacial change. While historical data suggests that the ice shelf in front of Pine Island Glacier is thinning and retreating, no major ice-shelf breakup was observed in 1996-2000. In contrast, a 20 percent reduction in basal traction of the glacier would explain the radar observations. The mechanisms by which enhanced bed lubrification could develop over such a short time period and over such a large area are however unclear.